

OSHPD/CSMIP
HOSPITAL INSTRUMENTATION

Annual Report
July 1, 2019 through June 30, 2020

OSHPD Agreement No. 19-20042
(DOC No. 1019-033R)

California Strong Motion Instrumentation Program
California Department of Conservation
California Geological Survey

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October 10, 2020

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I. INTRODUCTION

The California Strong Motion Instrumentation Program (CSMIP) of the California Geological Survey, Department of Conservation, performs installation, maintenance and data recovery for strong motion instrumentation in hospitals through an interagency agreement with the Office of Statewide Health Planning and Development (OSHDP). Funding strong motion instrumentation of hospitals through the interagency agreement is in lieu of normal building-permit fee funding referenced in Chapter 8 of the Public Resources Code.

Hospital buildings have been instrumented under eleven Interagency Agreements: 89-0046 (DOC 1089-025R), 92-3187 (DOC 1092-541R), 95-6011 (DOC 1095-570R), 98-9034 (DOC 1098-701R), 01-2069 (DOC 1001-753R), 04-5072 (DOC 1004-790R), 07-7071 (DOC 1007-911R), 10-1266 (DOC 1010-930R), 13-4097 (DOC 1013-960R), 16-7415 (DOC 1016-990R) and 19-20042 (DOC 1019-033R). The first ten agreements extended from July 1989 through June 2019, each covering a period of three fiscal years. The eleventh and most recent interagency agreement 19-20042 (DOC 1019-033R) extends from February 3, 2020 to February 2, 2023. The eleventh contract was approved by the Department of General Services (DGS) on March 24, 2020. This Report covers activities performed between February 3, 2020 and June 30, 2020 (FY19-20).

The code requirements regarding the instrumentation of hospitals have recently been updated. Previously, the code stipulated that OSHDP was responsible for subsidizing the maintenance of instrumentation installed at hospitals. With the updated requirements however, the code now requires hospital owners to pay for maintenance. This change is reflected in the most recent interagency agreement between OSHDP and CSMIP. When CSMIP discovers maintenance issues with hospital instrumentation, the issues are reported to OSHDP. OSHDP then either authorizes CSMIP to address the issue or advises the hospital owner that they are responsible for addressing it. If CSMIP performs maintenance on instrumentation that the hospital owner has responsibility for, the hospital owner can be billed to recoup the cost of the work performed.

During FY19-20, a site visit to buy-off the instrumentation at the Marin General Hospital Replacement Building in Greenbrae occurred. However, the system did not pass the SMIP acceptance test due to issues with the recorder. In addition, CSMIP continued to provide technical guidance and assistance to the general contractors and structural engineers on instrumentation projects currently underway (see Tables 2 and 3). Most notably, sensor locations were marked for the following three hospitals: University Medical Center Replacement

Hospital in Loma Linda, Hollywood Presbyterian Medical Center Acute Care Services Replacement Building in Los Angeles, and Kaiser Hospital Tower Expansion in Downey.

It is worth noting that the current coronavirus pandemic has impacted the progress and completion of hospital instrumentation projects. This is due in part to construction delays as well as travel restrictions that were put into place. For example, work at the St. Bernardine Hospital in San Bernardino had recently been suspended for a few months. It is a functioning hospital undergoing voluntary seismic improvements and in order to reduce exposure and protect workers and patients, construction activity halted. In addition, some companies have not authorized their staff to travel to perform instrumentation activities under the current covid-19 conditions, which has led to delays in installation.

II. HOSPITAL INSTRUMENTATION STATUS

Hospital buildings with instrumentation underway are listed in Tables 1, 2, and 3. Like most other hospitals recently instrumented by the CSMIP, the new stations will have near-real-time data communication capability to allow the recorded motion to be automatically transmitted to Sacramento after an earthquake where it will be automatically processed and made available for use in post-earthquake response by the OSHPD and the hospital owners.

1) Type 1 - OSHPD-Funded Regular Instrumentation of Hospitals (Table 1)

It was anticipated that the reference free-field station of the Santa Clara Valley Hospital (Replacement Bed Bldg. 1) in San Jose would be installed during FY19-20. However, delays in landscaping of the intended area has pushed installation of this free-field station to FY20-21. In addition, the instrumentation of the Miller Children's Hospital in Long Beach or the Presbyterian Intercommunity Hospital in Whittier is anticipated to occur in FY20-21.

2) Types 2 and 3 - Owner-Funded Instrumentation of Hospitals with CSMIP Guidance and Assistance (Tables 2 and 3)

In addition to the hospital instrumentation funded under the OSHPD/CSMIP contract discussed above, a significant component of CSMIP hospital instrumentation work involves detailed technical guidance and assistance with hospital instrumentation projects for which the owner absorbs the capital cost of instrumentation under OSHPD regulations. These may be in new hospitals (Type 2), or in existing hospitals being retrofitted (Type 3). Six CSMIP-assisted hospital instrumentation projects of this type are currently underway.

CSMIP guidance and assistance in the instrumentation of hospitals includes the following steps:

1. Development of the sensor locations or review of the proposed sensor locations from the design structural engineer, after study of the structural plans, to ensure sufficient number of sensors to characterize the building seismic response. An instrumentation planning meeting or conference call among the structural engineer, architect of record, OSHPD and CSMIP staff is held to discuss and develop consensus on sensor locations and number of sensors.
2. Establishment of the specific locations of all sensors, based on detailed study of the architectural plans by the design architect or SE. Sensor locations need to be avoid conflict

with other non-structural components and sensors need to be accessible after they are installed.

3. Development of the comprehensive, detailed design of the system, called the Technical Specifications Letter (TSL), by CSMIP staff. The TSL is provided to the owner, OSHPD, and the contractor, and is included in the plans. It specifies acceptable instruments and approved installation practices as well as details for the locations and interconnection of the components, to result in a well-installed project. The final instrumentation plans are approved by the OSHPD.
4. Sensor marking field visit by CSMIP staff with representatives of the owner, construction contractor and OSHPD Inspector of Record. During this visit the actual sensor locations are approved and physically marked on the structural members. During the subsequent work by the contractor, CSMIP staff approves the submittals, assists with problems and issues as they arise.
5. Acceptance field testing of the completed instrumentation system, some months or years later, by CSMIP staff. If problems are found in the installation or operation, the contractor is called back in for repairs, followed by a repeat of tests. Once the installed system is accepted, OSHPD is notified, and CSMIP takes on long-term maintenance of the instrumentation, as well as data recovery and processing, supported by OSHPD.
6. CSMIP staff prepare sensor location diagram, building descriptions and photo for the building, which are made available at the Center for Engineering Strong Motion Data (CESMD) after the instrumentation is completed.

Type 2 Instrumentation Projects

Five projects underway of Type 2 instrumentation are listed in Table 2. These hospital buildings have base-isolation and/or energy dissipation devices or use an Alternate Method of Compliance (AMOC) in their design. These are required to have owner-paid instrumentation installed during construction per the California Building Code and OSHPD regulations.

During FY19-20, a site visit to buy-off the instrumentation at the Marin General Hospital Replacement Building in Greenbrae occurred; however, the installed system did not pass the acceptance test due to issues with the recorder. It is anticipated that a replacement recorder will be installed in the 3rd quarter of FY20-21. Following the installation of the new recorder, CSMIP will schedule and perform an acceptance test on the system.

Additionally, sensor locations were marked for the following three hospitals: University Medical Center Replacement Hospital in Loma Linda, Hollywood Presbyterian Medical Center Acute Care Services Replacement Building in Los Angeles, and Kaiser Hospital Tower Expansion in Downey. CSMIP anticipates the installation and acceptance test of instrumentation to be completed at each of these three locations during FY20-21. Specifically, CSMIP anticipates site visits to buy-off the instrumentation at Loma Linda and Downey to occur in the 2nd quarter of FY20-21, and at Los Angeles in the 4th quarter of FY20-21.

Type 3 Instrumentation Projects

These buildings are retrofitted under the Voluntary Seismic Improvement (VSI) regulations. Because of an AMOC design used in their retrofit, these buildings are required to be instrumented at owner expense. St. Bernardine Hospital in San Bernardino is the only Type 3 hospital instrumentation project that remains to be instrumented. CSMIP anticipates marking sensor locations for this hospital during FY20-21.

3) Outline of the Report

In Section III of this report, the previously instrumented hospital buildings for which ongoing maintenance was performed throughout FY19-20 are listed. In Section IV, the strong-motion records that were obtained during FY19-20 at instrumented hospitals and their reference free-field sites are listed. A total of 21 earthquakes with magnitude 3.0 or larger were recorded at instrumented hospitals. This includes the M6.4 and M7.1 Ridgecrest Earthquakes in July 2019. All recordings can be viewed online and downloaded at www.strongmotioncenter.org. The fiscal report is included in Section V.

A total of 80 hospital buildings have been instrumented in the OSHPD/CSMIP project through the end of FY19-20. The locations of the 80 hospital buildings are shown on a probabilistic seismic hazard map in Appendix A. The hospital buildings and information about their structural systems are listed in the table in Appendix B. The number of strong-motion recorders at each building and the communication speed are also shown in the table as these will determine how quickly data can be recovered for application after earthquakes.

Regular Hospital Buildings (Type 1)
Instrumented under OSHPD/CSMIP Hospital Instrumentation Project

Hospital Name	CSMIP Sta. No.	OSHPD Approval No.	Year Built	No. of Stories	No. of Sensors	Completion Date
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57612 3
Reference free-field for **San Jose – Santa Clara Valley Hospital (Replacement Bed Bldg. 1)**
(CSMIP Sta. 23634)

Table 2

**New Hospital Buildings (Type 2) – Assisted Instrumentation
Base-Isolated or Alternate Method of Compliance**

(Owner-Funded with CSMIP Assistance and Guidance)

Hospital Name	CSMIP Sta. No.	OSHPD Approval No.	Year Built	No. of Stories	No. of Sensors	Completion Date
<u>Instrumentation Underway (in estimated order of completion)</u>						
1. Greenbrae (San Rafael) – Marin General Hospital Replacement Building						
	58M15	I 140004-21	ca. 2019	4/1	16+FF	FY 20-21
Special steel moment frames with SidePlate connections						
[TSL completed 5/4/16; Sensor locations marked 11/2/2017; Buy-off 2/13/2020]						
(To include a reference free-field station)						
2. Loma Linda – University Medical Center Replacement Hospital						
	23nnn	I 150010-36	ca 2020	16/2	42+FF	FY 20-21
Steel BRB and SidePlate moment frames isolated with triple pendulum bearings and viscous dampers.						
[TSL completed 4/26/17; Sensor locations marked 9/6/2018, 4/11/2019 and 1/30/2020]						
(To include a reference free-field station)						
3. Los Angeles - Hollywood Presbyterian Medical Center Acute Care Services Replacement Building						
	24nnn	I 17002-19-02	ca 2020	4/1	16	FY 20-21
Steel moment frames with SidePlate connections						
[TSL completed 10/26/17; Sensor locations marked 5/6/2020]						
(Pre-existing reference FF station: Los Angeles – Vermont & Fountain , CSMIP Sta. 24642)						
4. Downey – Kaiser Hospital Tower Expansion						
	14689	I 160024-19-02	ca 2020	6/partial	16+FF	FY 20-21
Steel moment frames with SidePlate connections.						
[TSL completed 5/24/18; Sensor locations marked 10/8/2019]						
(To include a reference free-field station)						
5. Marina Del Rey – Cedars-Sinai Medical Center Replacement Hospital						
	14nnn	I 180008-19-00	ca 2021	9/0	tbd	tbd
Steel moment frames with SidePlate connections.						
[Conference call to discuss instrumentation, 5/23/19]						
(To include a reference free-field station)						

Table 3

**Existing Hospital Buildings (Type 3) – Assisted Instrumentation
Voluntary Seismic Improvement (VSI) Projects**

(Owner-Funded with CSMIP Assistance and Guidance)

Hospital Name	CSMIP Sta. No.	OSHPD Approval No.	Year Design	No. of Stories	No. of Sensors	Installation Date
<u>Instrumentation Underway</u>						
1. San Bernardino – St. Bernardine Hospital (Central Tower)						
	24nnn	IL 082842-36	1972	6/0	12+FF	FY 20-21
	Steel moment frames (retrofit: add exterior steel frames with viscous dampers)					
	[TSL completed 12/1/16; instrumentation plans approved]					
	(To include a reference free-field station)					

III. HOSPITAL INSTRUMENTATION MAINTENANCE

During FY19-20, CSMIP technical staff performed periodic maintenance of the strong-motion instrumentation installed in the 80 previously instrumented hospital buildings, 61 of which have an associated free-field instrument. Since no installations were completed during FY19-20, a total of 80 buildings will be maintained during the next fiscal year (FY20-21).

The 80 hospital buildings instrumented as of the beginning of FY19-20 (buildings with an associated reference free-field station are indicated by an *), are listed alphabetically by city below:

- | | |
|-------------------|---|
| 1. Alameda | - Alameda Hospital * |
| 2. Bakersfield | - Kern County Hospital * |
| 3. Berkeley | - Alta Bates Hospital |
| 4. Burlingame | - Mills Peninsula Hospital * |
| 5. Castro Valley | - Sutter Eden Medical Center * |
| 6. Colton | - Arrowhead Regional Medical Center (base-isolated) * |
| 7. Crescent City | - Sutter Coast Hospital * |
| 8. Downey | - PIH Health Medical Center (VSI) * |
| 9. El Centro | - El Centro Regional Medical Center * |
| 10. Encino | - Encino Hospital (VSI) * |
| 11. Escondido | - Palomar West Medical Center, Central Plant |
| 12. Escondido | - Palomar West Medical Center, Main Tower * |
| 13. Eureka | - St. Joseph Hospital * |
| 14. Fairfield | - North Bay Medical Center * |
| 15. Fremont | - Kaiser Hospital * |
| 16. Fremont | - Washington Hospital (base isolated) * |
| 17. Gilroy | - St. Louise Hospital * |
| 18. Hemet | - Hemet Valley Medical Center * |
| 19. Indio | - JFK Memorial Hospital * |
| 20. Irvine | - Kaiser Sand Canyon Hospital * |
| 21. King City | - Mee Hospital * |
| 22. La Jolla | - Scripps Memorial Hospital (VSI) * |
| 23. La Jolla | - UCSD Hospital * |
| 24. La Jolla | - UCSD Jacobs Medical Center |
| 25. Lancaster | - Antelope Valley Hospital * |
| 26. Los Angeles | - Childrens Hospital |
| 27. Los Angeles | - Good Samaritan Hospital |
| 28. Los Angeles | - Hollywood Presbyterian Medical Center, Doctor's Tower (VSI) |
| 29. Los Angeles | - Hollywood Presbyterian Medical Center, South Wing (VSI) * |
| 30. Los Angeles | - LAC+USC Hospital D&T (base-isolated) * |
| 31. Los Angeles | - LAC+USC Hospital Inpatient Bldg |
| 32. Los Angeles | - MLK Hospital (base-isolated) * |
| 33. Los Angeles | - USC Hospital (base-isolated) |
| 34. Los Angeles | - USC Hospital Addition |
| 35. Mammoth Lakes | - Mammoth Hospital * |
| 36. Moreno Valley | - Riverside County Hospital * |
| 37. Murrieta | - Rancho Springs Medical Center * |

- | | |
|--------------------|--|
| 38. Newport Beach | - Hoag Hospital West Tower * |
| 39. Newport Beach | - Hoag Hospital East Tower (base-isolated) |
| 40. Novato | - Community Hospital * |
| 41. Oakland | - Kaiser Hospital |
| 42. Ontario | - Kaiser Hospital * |
| 43. Oxnard | - St. John's Medical Center * |
| 44. Palm Springs | - Desert Hospital |
| 45. Palmdale | - Palmdale Regional Medical Center * |
| 46. Palo Alto | - Lucile Packard Children's Hospital Stanford * |
| 47. Redlands | - Community Hospital (VSI) * |
| 48. Riverside | - Community Hospital (VSI) * |
| 49. Salinas | - Natividad Medical Center * |
| 50. San Bernardino | - Community Hospital * |
| 51. San Diego | - Sharp Memorial Hospital (VSI) * |
| 52. San Diego | - UCSD Medical Center * |
| 53. San Francisco | - CPMC Cathedral Hill Hospital |
| 54. San Francisco | - General Hospital (base-isolated) * |
| 55. San Francisco | - Kaiser Hospital |
| 56. San Francisco | - St. Luke's Hospital |
| 57. San Francisco | - UCSF Hospital * |
| 58. San Francisco | - UCSF Mission Bay Hospital * |
| 59. San Jose | - O'Connor Hospital * |
| 60. San Jose | - Santa Clara Valley Hospital Bed Bldg 1 |
| 61. San Jose | - Santa Clara Valley Hospital Bldg K |
| 62. San Pedro | - Providence LCOM Medical Center Bldg 1T (VSI) * |
| 63. San Pedro | - Providence LCOM Medical Center Bldg 2 (VSI) |
| 64. San Rafael | - Marin General Hospital West Wing * |
| 65. Santa Ana | - Orange County Global Med Center (VSI) * |
| 66. Santa Barbara | - Cottage Hospital * |
| 67. Santa Clara | - Kaiser Hospital * |
| 68. Santa Maria | - Marian Hospital * |
| 69. Santa Monica | - St. John's Hospital (base-isolated) * |
| 70. Santa Rosa | - Kaiser Hospital * |
| 71. Simi Valley | - Simi Valley Hospital * |
| 72. Stanford | - 7-story Hospital (base-isolated) * |
| 73. Stanford | - University Hospital * |
| 74. Sylmar | - Olive View Hospital * |
| 75. Templeton | - Twin Cities Hospital * |
| 76. Torrance | - Providence LCOM Medical Center (VSI)* |
| 77. Valencia | - Mayo Hospital * |
| 78. Ventura | - Community Memorial Hospital * |
| 79. Ventura | - Ventura County Hospital * |
| 80. Walnut Creek | - Kaiser Hospital |

CSMIP also performs monitoring and data recovery for the code-type instrumentation systems (three tri-axial accelerographs) in the following four hospitals without charge to OSHPD:

1. Los Angeles – White Memorial Hospital (7-story)

2. Pasadena – Huntington Memorial Hospital (7-story)
3. Downey – Kaiser Hospital (6-story)
4. Los Angeles – Kaiser LAMC Sunset Hospital (7-story)

IV. STRONG-MOTION RECORDS FROM HOSPITALS

From July 1, 2019 to June 30, 2020 a total of 21 earthquakes with magnitude 3.0 or larger were recorded at the instrumented hospitals. This includes the M6.4 and M7.1 Ridgecrest Earthquakes of July 2019. The hospitals, and the maximum accelerations recorded at the hospital buildings (base and superstructure) and at their reference free-field stations (ground), are listed below for these earthquakes.

M6.4 Ridgecrest Earthquake of July 04, 2019

Name of Hospital	Type of Structure	Epicentra Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Lancaster – Antelope Valley Hospital (Sta. 24609)	5-story steel moment frames	127.5	---	5.7	27.5
Palmdale – Regional Medical Center (Sta. 24457)	5-story concrete shear walls	137.4	3.5	4.4	11.9
San Bernardino – Community Hospital (Sta. 23634)	5-story steel moment frames	175.4	--	1.5	6.3
Los Angeles – Children’s Hospital (Sta. 24397)	7-story steel moment frames	192.2	No FF	1.3	5.4
Oxnard – St. Johns Hospital (Sta. 25949)	4-story steel moment frames	223.5	--	1.2	1.9
Los Angeles – USC Hospital Addition (Sta. 24260)	9-story concentrically braced steel frames	193.1	No FF	1.1	6.3
Bakersfield – Kern County Hospital (Sta. 34234)	4-story concrete shear walls	127.6	1.1	1.1	1.9
Los Angeles – LAC+USC Hospital IP Bldg (Sta. 24248)	9-story concentrically braced steel frames	193.7	No FF	1.0	3.5
Irvine – Kaiser Sand Canyon Hospital (Sta. 13439)	6-story steel buckling restrained braced frames	228.4	1.1	1.0	3.1
Sylmar – Olive View Medical Center (Sta. 24514)	6-story concrete shear walls	175.4	--	1.0	2.5
Moreno Valley – Riverside County Hospital (Sta. 13213)	3-story steel moment frames	200.9	--	1.0	2.4
Riverside – Community Hospital (Sta. 13633)	6-story concrete shear walls	192.2	--	0.9	5.0
Palm Springs – Desert Hospital (Sta. 12299)	4-story steel moment frames	225.1	No FF	0.8	2.9

Ontario – Kaiser Hospital (Sta. 23416)	5-story steel buckling restrained braced frames	185.9	1.1	0.8	3.0
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M7.1 Ridgecrest Earthquake of July 05, 2019

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Lancaster – Antelope Valley Hospital (Sta. 24609)	5-story steel moment frames	130.3	--	6.9	24.1
Palmdale – Regional Medical Center (Sta. 24457)	5-story concrete shear walls	140.6	3.9	3.8	14.3
Ventura – County Hospital (Sta. 25744)	4-story concrete shear walls	224.1	No FF	2.8	7.1
Santa Ana – Western Medical Center (Sta. 13611)	1-story steel X-braces	224.5	--	2.7	2.8
San Bernardino – Community Hospital (Sta. 23634)	5-story steel moment frames	183.4	--	2.6	12.3
Los Angeles – Children’s Hospital (Sta. 24397)	7-story steel moment frames	195.9	No FF	2.2	6.5
Irvine – Kaiser Sand Canyon Hospital (Sta. 13439)	6-story steel buckling restrained braced frames	234.7	2.1	2.1	7.1
Valencia – Mayo Hospital (Sta. 24344)	2-story steel moment frames and x-braced frames	175.3	--	1.9	4.1
Encino – Encino Hospital Building 3 (Sta. 24648)	4-story concrete shear walls	196.4	1.9	1.8	6.5
Bakersfield – Kern County Hospital (Sta. 34234)	4-story concrete shear walls	131.5	1.6	1.7	4.1
Sylmar – Olive View Medical Center (Sta. 24514)	6-story concrete shear walls	177.8	1.7	1.6	4.5
Los Angeles – LAC+USC Hospital IP Bldg (Sta. 24248)	9-story concentrically braced steel frames	197.9	No FF	1.5	4.8
Los Angeles – USC Hospital Addition (Sta. 24260)	9-story concentrically braced steel frames	197.3	--	1.5	6.0
Oxnard – St. Johns Hospital (Sta. 25949)	4-story steel moment frames	223.3	--	1.5	3.5
Moreno Valley – Riverside County Hospital (Sta. 13213)	3-story steel moment frames	209.3	--	1.5	3.8
Riverside – Community Hospital (Sta. 13633)	6-story concrete shear walls	200.0	1.5	1.3	11.9
Palm Springs – Desert Hospital (Sta. 12299)	4-story steel moment frames	235.1	No FF	1.3	6.2

Ontario – Kaiser Hospital (Sta. 23416)	5-story steel buckling restrained braced frames	192.7	1.6	1.3	6.2
San Pedro - Providence LCOM Hospital Bldg 1T (Sta. 14535)	5-story steel moment frames and x-braced frames	234.4	--	0.8	2.9
Mammoth Lakes – Mammoth Hospital (Sta. 54331)	1-story steel chevron braced frames	241.1	--	0.5	2.4

M5.4 Little Lake Earthquake of July 05, 2019

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (% g)		
			Ground	Base	Structure
Bakersfield – Kern County Hospital (Sta. 34234)	4-story concrete shear walls	130.3	--	0.7	1.6

M4.5 Pleasant Hill Earthquake of October 14, 2019

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (% g)		
			Ground	Base	Structure
Fairfield – NorthBay Medical Center (Sta. 68032)	3-story steel eccentrically braced frames and moment frames	36.0	8.9	7.4	16.5
Walnut Creek – Kaiser Hospital (Sta. 58199)	3-story steel moment frames	5.1	No FF	3.3	8.3
Berkeley – Alta Bates Hospital (Sta. 58496)	2-story eccentrically braced steel frames	19.8	No FF	1.1	2.0
Fremont – Kaiser Hospital (Sta. 57301)	2-story steel moment frames and braced frames	43.4	--	0.4	1.5
Santa Clara – Kaiser Hospital (Sta. 57251)	3-story chevron braced and buckling-restrained braced steel frames	67.1	---	0.4	1.8

M4.7 Tres Pinos Earthquake of October 15, 2019

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (% g)		
			Ground	Base	Structure
Salinas – Natividad Medical Center (Sta. 47796)	3-story chevron-braced steel frames	32.6	0.6	0.5	1.8

M3.5 Compton Earthquake of October 18, 2019

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (% g)		
			Ground	Base	Structure
Los Angeles – LAC+USC Hospital IP Bldg (Sta. 24248)	9-story concentrically braced steel frames	18.4	No FF	1.1	1.3

M3.6 Toms Place Earthquake of December 26, 2019

			Max. Horizontal Acceleration (% g)		

Name of Hospital	Type of Structure	Epicentral Distance (km)	Ground	Base	Structure
Mammoth Lakes – Mammoth Hospital (Sta. 54331)	1-story steel chevron braced frames	14.2	---	2.3	11.1

M3.6 Granada Hills Earthquake of January 21, 2020

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Sylmar – Olive View Medical Center (Sta. 24514)	6-story concrete shear walls	4.6	2.7	3.3	6.2

M4.4 Toms Place Earthquake of February 01, 2020

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Mammoth Lakes – Mammoth Hospital (Sta. 54331)	1-story steel chevron braced frames	13.9	---	6.5	35.4

M4.9 Anza Earthquake of April 03, 2020

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Indio – JFK Hospital (Sta. 12759)	1-story plywood shear walls	34.8	---	4.4	13.3
Hemet – Valley Hospital (Sta. 12267)	4-story concrete shear walls	51.1	3.3	1.8	4.2
Moreno Valley – Riverside County Hospital (Sta. 13213)	3-story steel moment frames	79.3	---	1.2	3.7
Palm Springs – Desert Hospital (Sta. 12299)	4-story steel moment frames	38.9	No FF	1.1	1.9

M4.0 Toms Place Earthquake of April 05, 2020

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Mammoth Lakes – Mammoth Hospital (Sta. 54331)	1-story steel chevron braced frames	16.2	---	3.2	16.9

M5.2 Bodie Earthquake of April 11, 2020

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Mammoth Lakes – Mammoth Hospital (Sta. 54331)	1-story steel chevron braced frames	49.6	---	0.7	4.0

M4.6 Bodie Earthquake of April 11, 2020

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (%g)		
			Ground	Base	Structure
Mammoth Lakes – Mammoth Hospital (Sta. 54331)	1-story steel chevron braced frames	47.7	---	0.4	1.9

M3.7 View Park-Windsor Hills Earthquake of April 22, 2020

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (% g)		
			Ground	Base	Structure
Santa Monica – St. John’s Hospital (Sta. 24202)	5-story concentrically braced steel frames	12.8	No FF	1.1	2.2
Los Angeles – LAC+USC Hospital IP Bldg (Sta. 24248)	9-story concentrically braced steel frames	15.3	No FF	0.7	1.5

M4.5 Ocotillo Wells Earthquake of May 10, 2020

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (% g)		
			Ground	Base	Structure
El Centro – Community Hospital (Sta. 01699)	1-story tube braces and concrete block walls	49.8	---	1.0	2.2

M6.5 Monte Cristo Range Earthquake of May 15, 2020

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (% g)		
			Ground	Base	Structure
Mammoth Lakes – Mammoth Hospital (Sta. 54331)	1-story steel chevron braced frames	111.4	---	1.2	6.5

M3.7 Oildale Earthquake of May 26, 2020

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (% g)		
			Ground	Base	Structure
Bakersfield – Kern County Hospital (Sta. 34234)	4-story concrete shear walls	0.6	---	0.6	2.2

M5.5 Oildale Earthquake of May 26, 2020

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (% g)		
			Ground	Base	Structure
Lancaster – Antelope Valley Hospital (Sta. 34234)	5-story steel moment frames	122.6	---	1.1	2.8
Palmdale – Regional Medical Center (Sta. 24457)	5-story concrete shear walls	132.0	---	0.9	2.6

M3.4 Alum Rock Earthquake of June 17, 2020

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (% g)		
			Ground	Base	Structure
Fremont – Kaiser Hospital (Sta. 57301)	2-story steel moment frames	24.3	---	0.6	1.5

M5.8 Lone Pine Earthquake of June 24, 2020

Name of Hospital	Type of Structure	Epicentral Distance (km)	Max. Horizontal Acceleration (% g)		
			Ground	Base	Structure

Bakersfield – Kern County Hospital (Sta. 34234)	4-story concrete shear walls	148.4	---	1.0	2.2
Mammoth Lakes – Mammoth Hospital (Sta. 54331)	1-story steel chevron braced frames	159.4	---	0.8	2.9

The strong-motion records are made available rapidly after an earthquake by the CSMIP Strong-motion Automated Recovery and Analysis (SARA) system, and posted in the Internet Quick Reports at the web site of the Center for Engineering Strong Motion Data (CESMD), at <https://www.strongmotioncenter.org>.

The largest earthquake during FY19-20 was the M7.1 Ridgecrest earthquake of July 5, 2019. This earthquake was recorded by 20 different hospital stations. The largest acceleration recorded from this earthquake is from the 5-story steel moment frame Antelope Valley Hospital building in Lancaster. The peak accelerations were 0.069 g at the base of the building, and 0.24 g at the roof. The accelerations recorded in the building are plotted in Figure 1.

The largest acceleration recorded during FY19-20 is from the Mammoth Hospital during the M4.4 Toms Place earthquake of February 1, 2020. The building is a 1-story steel concentrically braced-frame structure with a partial penthouse and is located 13.9 km from the earthquake epicenter. The acceleration record is shown in Figure 2. The peak accelerations recorded are 0.065 g at the base, 0.10 g at the roof, and 0.35 g at the penthouse roof. This record shows significant amplification of acceleration at the penthouse roof. Significant amplification of motion at the penthouse roof has been observed in records from other low-rise hospital buildings in previous earthquakes.

V. FISCAL REPORT

Expenditures and Department of Conservation billings to OSHPD are summarized in the following:

Total amount of Agreement (February 3, 2020 - February 2, 2023) \$1,133,700.00

1) Budgeted for Year 1 (FY19-20) \$377,900.00

The contract was approved by the Department of General Services (DGS) on March 24, 2020. The invoice for the charges in FY2019-20 is being prepared to submit to OSHPD.

Lancaster - 5-story Hospital CGS/OSHPD Sta 24609
 Rcd of Fri Jul 5, 2019 20:20 (Time Approx.) (WWVB)
 Frequency Band Processed: 15.0 secs to 40.0 Hz
 CISM/CSMIP Preliminary Strong Motion Processing - Subject to Revision

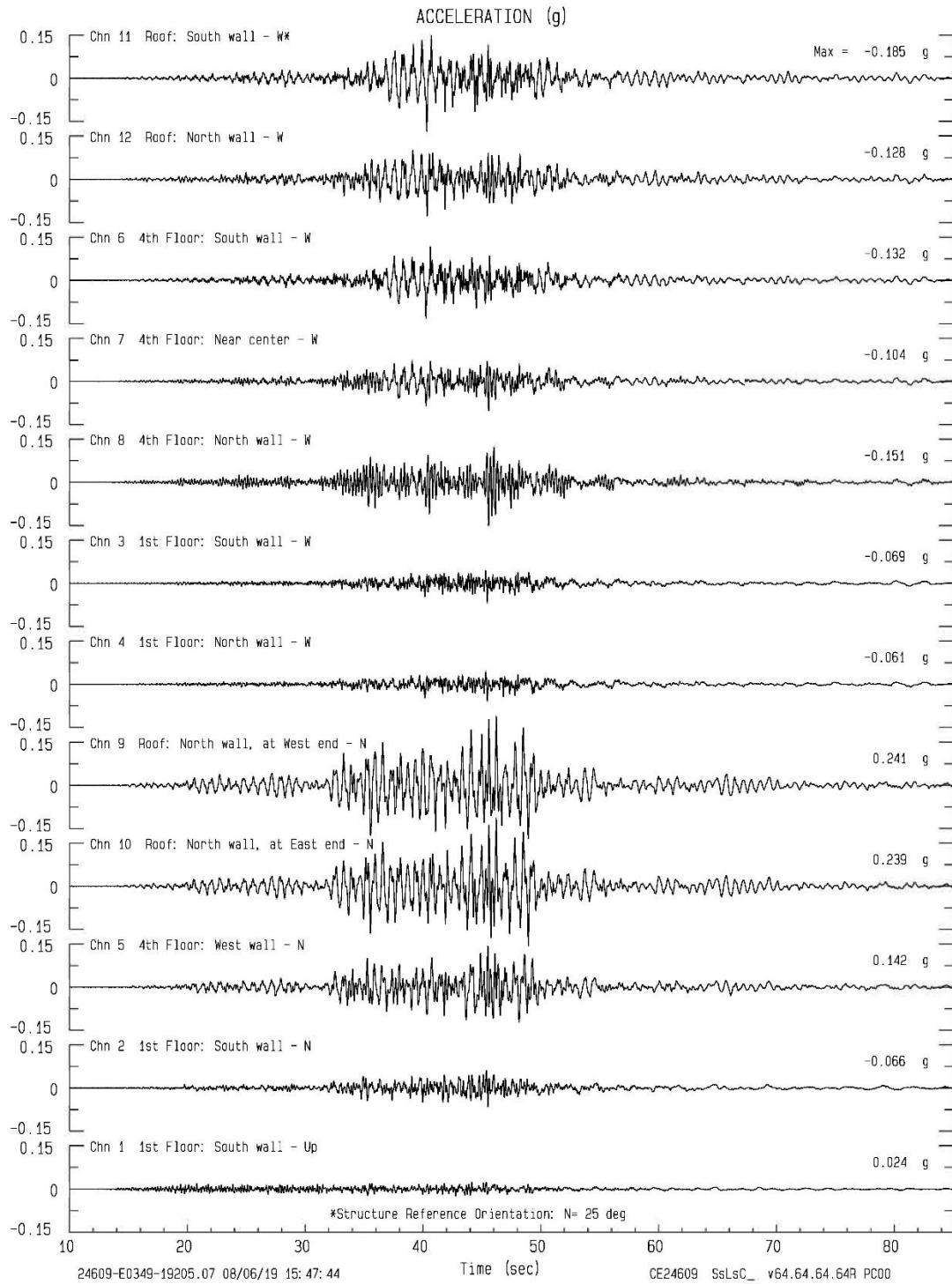


Figure 1. Accelerations recorded at the Antelope Valley Hospital in Lancaster during the M7.1 Ridgecrest earthquake of July 5, 2019.

Mammoth Lakes - 1-story Hospital CGS/OSHDP Sta 54331
 Rcrd of Sat Feb 1, 2020 10:36:28.0 PST (GPS)
 Frequency Band Processed: 3.3 secs to 40.0 Hz
 CISN/CSMIP Preliminary Strong Motion Processing - Subject to Revision

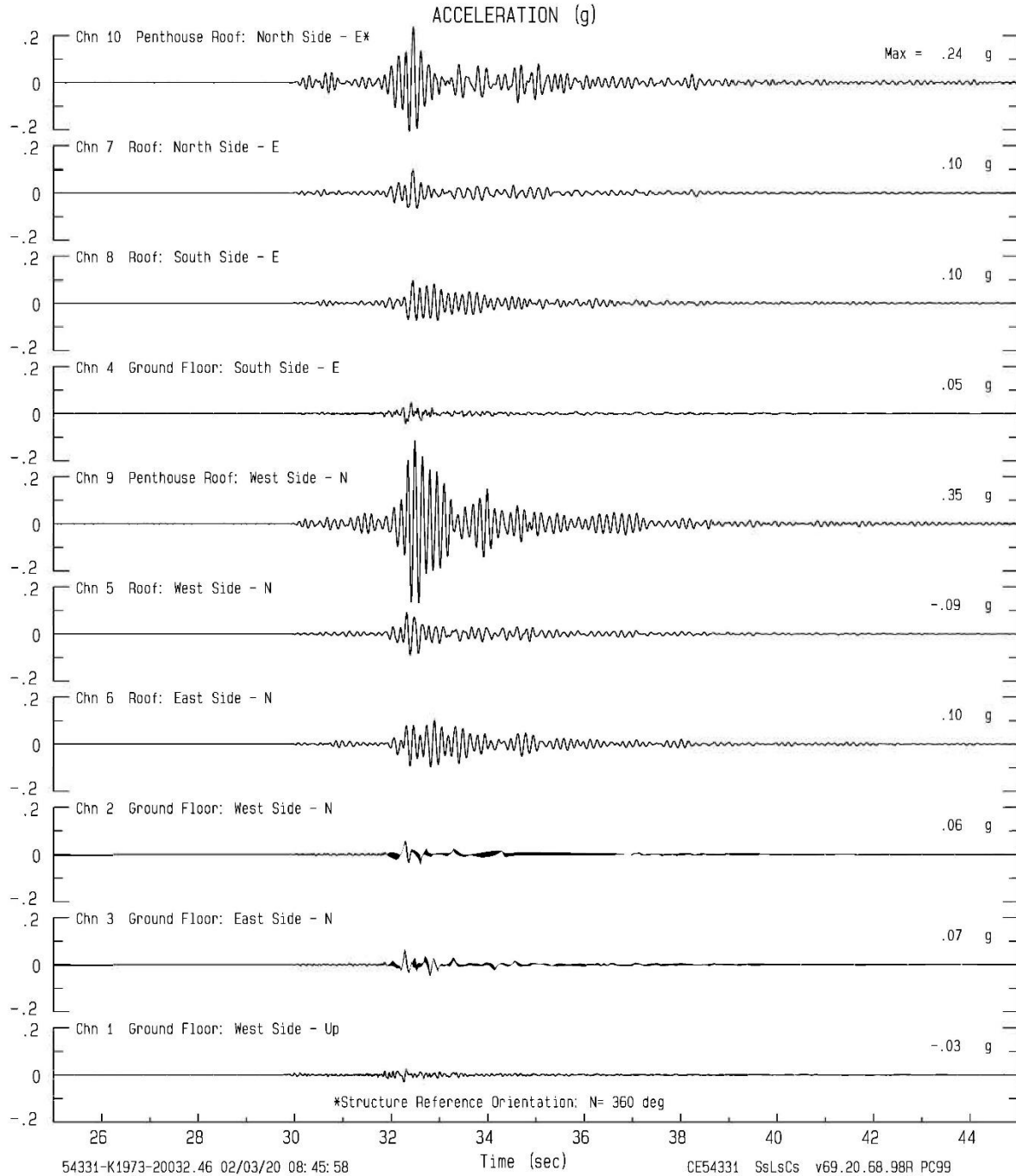


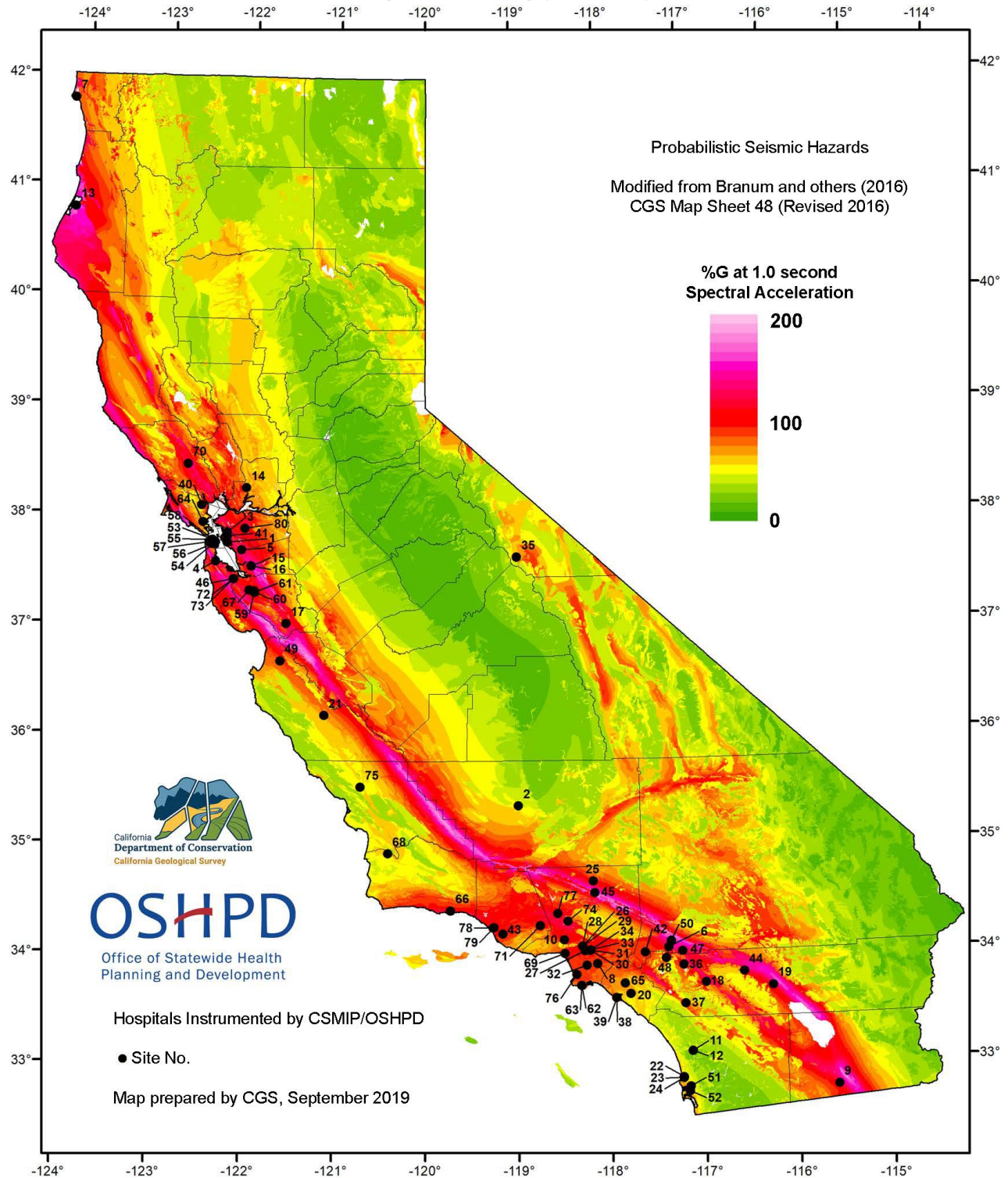
Figure 2. Accelerations recorded at the Mammoth Hospital in Mammoth Lakes during the M4.4 Toms Place earthquake of February 1, 2020.

Appendix A

Hospitals Instrumented by CSMIP/OSHPD

2% Chance of Being Exceeded in 50 years

Long-Period Shaking (1.0 second)



Appendix B

BUILDINGS INSTRUMENTED BY CSMIP/OSHPD

10/1/2019

Site No. on Map	CSMIP Sta. No.	Station Name	No. of Stories	No. of Sensors	No. of Rcrdrs	Recov. Speed	FEMA-310 Bldg Type	SMIAC Bldg Type
1	58396	Alameda - Alameda Hospital	3/0	12+FF	1	M	S1L	K1
2	34234	Bakersfield - Kern County Hospital	4/1	12+FF	1	L	C2M	H2b
3	58496	Berkeley - Alta Bates Hospital	2/1	12	1	L	S2L	I1c
4	58390	Burlingame - Mills Peninsula Hospital (isolated)	6/0	27+FF	1	M	IM	Q2
5	58494	Castro Valley - Sutter Eden Medical Center	6/1	19+FF	1	M	S2M	I2a
6	23788	Colton - San Bernardino Co. Med. Center (isolated)	6/0,4/0,2/0	27+FF	2	L	IM	Q2
7	99261	Crescent City - Sutter Hospital	1/0	10+FF	1	L	S2L	I1c
8	14646	Downey - PIH Health Hospital (VSI)	4/1	12+FF	1	M	C2M	G2b
9	01699	El Centro - Community Hospital	1/0	12+FF	4	VL	S2L	I1b
10	24648	Encino - Encino Hospital (VSI)	4/1	12+FF	1	H	RM2M	F2a
11	13476	Escondido - PMC West Hospital Central Plant	2/0	6	1	M	C2L	H1f
12	13473	Escondido - PMC West Hospital (Main Tower)	11/1	12+FF	1	M	S1H	K3a
13	89770	Eureka - St. Joseph Hospital	4/1	11+FF	1	L	C2M	G2d
14	68032	Fairfield - NorthBay Medical Center	3/0	12+FF	1	L	S2L	I1d
15	57301	Fremont - Kaiser Hospital	2/0	15+FF	1	L	S1L	K1
16	57643	Fremont - Washington Hospital (isolated)	3/1	24+FF	1	M	IL	Q1
17	57200	Gilroy - St. Louise Hospital	2/0	10+FF	1	L	S1L	K1
18	12267	Hemet - Valley Hospital	4/1	10+FF	1	L	C2M	G2d
19	12759	Indio - JFK Hospital	1/0	8+FF	2	VL	W1	A1
20	13439	Irvine - Kaiser Sand Canyon Hospital	6/partial	15+FF	1	M	S2M	I2b
21	47231	King City - Mee Hospital	2/0	10+FF	1	L	S2L	I1c
22	03538	La Jolla - Scripps Memorial Hospital	7/1	12+FF	1	M	S1M	J2b
23	03233	La Jolla - UCSD Hospital	2/0	16+FF	1	L	S1L	J1b
24	03593	La Jolla - UCSD Jacobs Medical Center	10/2	24	1	M	S1H	K3a
25	24609	Lancaster - Antelope Valley Hospital	5/0	12+FF	3	VL	S1M	K2
26	24397	Los Angeles - Childrens Hospital	7/1	12	1	L	S1M	K2
27	24713	Los Angeles - Good Samaritan Hospital	8/1	15	5	VL	S2H	I3b
28	24662	Los Angeles - Hollywood Presbyterian MC S. Wing (VSI)	4/1	12+FF	1	M	C2M	H2b
29	24682	Los Angeles - Hollywood Presbyterian MC Drs Tower (VSI)	10/2	15	1	M	S1H	J3b
30	24250	Los Angeles - LAC+USC Hospital D&T Bldg (isolated)	6/0	20+FF	2	L	IM	Q2
31	24248	Los Angeles - LAC+USC Hospital IP Bldg	9/0	12	1	L	S2H	I3b
32	14724	Los Angeles - MLK Hospital (isolated)	5/1	21+FF	2	L	IM	Q2
33	24605	Los Angeles - USC Hospital (isolated)	7/1	24	7	VL	IH	Q3
34	24260	Los Angeles - USC Hospital Addition	9/1	12	1	L	S2H	I3b
35	54331	Mammoth Lakes - Mammoth Hospital	1/0	10+FF	1	L	S2L	I1b
36	13213	Moreno Valley - Riverside County Hospital	3/1	12+FF	1	L	S1L	K1
37	13601	Murrieta - Rancho Springs Medical Center	2/0	9+FF	1	M	C1L	L1
38	13291	Newport Beach - Hoag Hospital East Tower (isolated)	7/1	27	5	VL	IM	Q3
39	13589	Newport Beach - Hoag Hospital West Tower	11/0	18+FF	2	L	C2H	H3a
40	68430	Novato - Community Hospital	2/0	12+FF	1	M	S2L	I1b
41	58590	Oakland - Kaiser Hospital	12/1	18	1	M	S2H	I3b
42	23416	Ontario - Kaiser Hospital	5/partial	18+FF	1	M	S2M	I2b
43	25949	Oxnard - St. Johns Hospital	4/1	16+FF	1	L	S1M	K2
44	12299	Palm Springs - Desert Hospital	4/1	13	1	L	S1M	K2
45	24457	Palmdale - Palmdale Regional Hospital	5/0	16+FF	1	M	C2M	H2d
46	58604	Palo Alto - Lucile Packard Childrens Hospital Stanford	6/2	21	2	M	S2M	J2a
47	23548	Redlands - Community Hospital (VSI)	2/1	9+FF	1	M	C2L	H1c
48	13633	Riverside - Community Hospital (VSI)	6/1	12+FF	1	M	C2M	G2e
49	47796	Salinas - Natividad Medical Center	3/0	15+FF	1	L	S2L	I1b
50	23634	San Bernardino - Community Hospital	5/0	12+FF	1	M	S1M	K2

Appendix B

BUILDINGS INSTRUMENTED BY CSMIP/OSHPD

10/1/2019

Site No. on Map	CSMIP Sta. No.	Station Name	No. of Stories	No. of Sensors	No. of Rcrdrs	Recov. Speed	FEMA-310 Bldg Type	SMLAC Bldg Type
51	03546	San Diego - Sharp Memorial Hospital (VSI)	8/1	15+FF	1	M	C2H	H3b
52	03743	San Diego - UCSD Hospital	11/1	12+FF	4	VL	C1H	M3
53	58640	San Francisco - CPMC Cathedral Hill Hospital	12/2	24	1	H	S1H	K3a
54	58574	San Francisco - General Hospital (isolated)	7/2	24+FF	2	M	IM	Q2
55	58718	San Francisco - Kaiser Hospital	6/0	18	6	VL	C2M	H2d
56	58649	San Francisco - St. Luke's Hospital	6/1	16	1	M	S2M	I2b
57	58257	San Francisco - UCSF Hospital	15/1	16+FF	1	L	U	U
58	58572	San Francisco - UCSF Mission Bay Hospital	6/0	18+FF	1	M	S2M	I2b
59	57594	San Jose - O'Connor Hospital	5/0	16+FF	4	VL	S2M	I2c
60	57495	San Jose - Santa Clara Valley Hospital (Bldg K)	4/1	15	1	M	S1M	K2
61	57537	San Jose - Santa Clara Valley Hospital (Bed Bldg 1)	7/1	20+FF	1	M	S1M	K2
62	14535	San Pedro - Providence LCOM Hosp (Bldg 1T) (VSI)	5/partial	12+FF	1	M	S2M	I2d
63	14536	San Pedro - Providence LCOM Hosp (Bldg 02) (VSI)	4/1	12	1	M	C2M	H2d
64	58755	San Rafael - Marin General Hospital	5/1	12+FF	1	L	S1M	J2b
65	13611	Santa Ana - Orange County Global Medical Center (VSI)	1/0	6+FF	1	M	S2L	I1a
66	25777	Santa Barbara - Cottage Hospital	3/1	9+FF	3	VL	C2L	H1e
67	57251	Santa Clara - Kaiser Hospital	3/1	18+FF	1	L	S2L	I1b
68	26470	Santa Maria - Marian Hospital	4/partial	12+FF	1	M	S2M	I2c
69	24202	Santa Monica - St. John's Hospital (isolated)	5/1	24+FF	2	L	IM	Q2
70	68669	Santa Rosa - Kaiser Hospital	4/1	13+FF	5	VL	S1M	K2
71	24104	Simi Valley - Simi Valley Hospital	2/1	12+FF	1	L	S1L	K1
72	58623	Stanford - 7-story Hospital (isolated)	7/1	34+FF	1	M	IM	Q2
73	58055	Stanford - University Hospital	3/1	12+FF	1	L	S1L	K1
74	24514	Sylmar - Olive View Medical Center	6/0	13+FF	1	L	UM	R
75	36695	Templeton - Twin Cities Hospital	1/0	9+FF	3	VL	W1	A1
76	14529	Torrance - Providence LCOM Hospital (VSI)	4/2	21+FF	2	M	C2M	H2d
77	24344	Valencia - Mayo Hospital	2/partial	12+FF	1	M	S1L	K1
78	25594	Ventura - Community Memorial Hospital	6/1	24+GA	2	M	S2M	I2b
79	25744	Ventura - County Hospital	4/1	12+FF	3	VL	C2M	H2b
80	58199	Walnut Creek - Kaiser Hospital	3/1	16	1	L	S1L	K1